CHOOSING A DATABASE SYSTEM FOR HANKAM DEPARTMENT

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NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

CHOOSING A DATABASE SYSTEM
FOR HANKAM DEPARTMENT

by

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The thesis discusses the selection of the many database systems available. It is intended to supplement the current Master Plan but may affect the Master Plan itself. The future information flow overview, throughout the entire department and its subordinates, can be used as a long term framework and guidance for the development which may improve support from and reduce future potential conflict with the MIS development of the Armed Forces.

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Choosing a Database System for HANKAM Department

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I. INTRODUCTION

The basic characteristic of a computer is its capability to provide useful information with a tremendous speed, by manipulating a given set of data, in accordance with a certain processing algorithm which is called a program. This characteristic applies to all computer usage, although a specific computer may have a different internal organization and configuration.

Several computer applications in the organization which refer to Automatic Data Processing (ADP) or Electronic Data Processing (EDP) are:

1) Automation of office paper work or clerical work.
2) Providing information for monitoring and controlling the activities at the operational level by the management and for record keeping.
3) Providing information for supporting a decision making process at the middle and upper management levels.

Generally the three applications are covered within one organizational function which conducts the operation of the information system of the organization.

The HANKAM/Armed Forces[1] is a complex nation wide organization with roughly three hundred thousand people,

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[1] HANKAM/Armed Forces refers to HANKAM Department and Armed Forces components. Armed Forces components are Army, Navy, Air Force, and Police.

which is 0.2% of Indonesia's population. In using modern management principles to cope with today's fast changing environment, ADP services are needed. A great amount of data originating from the activities of the sub-organizations should be processed systematically. Frequently the management does not have adequate information in terms of its accuracy, completeness, timeliness, and consistency to support their decision making process. On the other hand, with the manual system, the staff officers are burdened with a tremendous amount of paper work.

The data which are gathered at the HANKAM staff and planning level come from five main sources, namely: Army, Navy, Air Force, Police, and HANKAM Supporting Activity Agencies. It is originated and generated in the operational level of the organization. The data is gathered, filtered, and summarized during its flow along the path of the organization hierarchical structure. Some are used in each decision point within each hierarchical level to perform their internal function.

Considering the ability of computers for data or string manipulation and computing, the HANKAM Department decided to improve its information system by using computer as a tool. It is widely known that for an organization that possesses a good management, a computerization of its information system may improve further the performance of the organization. But ADP may make poor management worse. Therefore an improvement of the management function may be necessary prior to computerization.

A master plan for the development is important in setting the overall objectives. It gives directions to the evolution of the development. While the current stage of the HAWAII system development is mostly in the system identification, system study, and system definition phases, this thesis discusses a proposed database system to support the existing master plan. Hence it is assumed that the database system has not been selected.

II. BACKGROUND

In 1967 the management of the HANKAM Department realized the need for improving its information system. The idea of having a computerized information system has been accepted. The introduction of the system approach in managing an organization in the late 1960's and the economic development and growth of the nation after 1966 contributed to the acceptance of the idea. Since then several studies with regard to the department MIS development plan have been conducted. As a result, a master plan for the development was formulated in 1972 and approved in 1973.

Two major aspects of the master plan are the computer with its information flow and operational research/system analysis. This thesis has a close relation with the first aspect.

In 1975 HANKAM ADP Centre with its computer, UNIVAC 1106, was established. The current hardware acquisition was intended primarily to support the preparation for future operation of the information system. Currently it is used to process personnel and material census, to support training programs, to gain experience and expertise in computer operation and programming, and to being used for several computational applications.

Organizationally, HANKAM ADP Centre is one of the many HANKAM Supporting Activity agencies. The mission is to give

assistance to the HANKAM Minister/Commander in Chief in managing the computer based HANKAM MIS and to perform data processing and information presentation at the department level. In 1976 similar agencies were established at headquarter level for the armed services. These agencies opened formal channels for development coordination of the overall system as well as initiating activity on the system development at the armed forces level. What has to be done more is towards the management of standardization problems. All parties agree that ignorance of standardization will create inefficient future system operation since most of the data for the HANKAM department will be collected from the armed forces. But it is hard to establish those standards without specifying in more detail how the system will operate in the future.

The introduction of database processing gives further insight into the problems. Developed countries who pioneered in the use of computers in organization have suffered in trying to convert their file processing system into a database processing system. The conversion is intended for more responsiveness to management for ad hoc information requests, data availability, integrity, and security. This experience can be used by those who build a computerized information system from scratch.

The standardization area for database software is mainly in the data dictionary, as part of the schema, and database management system (DBMS). However, future trends of the DBMS development is still in question. The possibility of having

multiple database management systems (heterogeneous DBMS) is still under study [Ref. 1]. It is also influenced by hardware developments such as the back-end computer (database computer).

Before deciding on hardware and software standardization, the author thinks it is more important first to decide in the near future, whether the department should have a centralized data processing system, a distributed data processing system, or a distributed system. Each of the systems have different restrictions regarding standardization, software, hardware, and database systems.

III. DATABASE SYSTEMS

A. FILE PROCESSING vs DATABASE PROCESSING

1. File Processing System

File processing is designed for a specific application. It is usually efficient for the application but subject to data dependency. Storage structure of a file processing system is embedded or locked in its application program, which interacts with the operating system. A new application involving the same data or some of it:

1) Creates redundancy.

2) Needs to construct a new version of the same data.

3) Needs data reorganization and recoding.

The conversion is time consuming and needs a lot of effort. Nolan has a vignette [Ref. 2] which shows that it requires nine months to one year to have a new application utilizing available data from several other applications. Too many different application programs create data incompatibilities due to difficulties in the updating process. According to Martin [Ref. 3]:

> In a large data-processing operation without a data base there are so many redundant data that it is virtually impossible to keep them all at the same level of update. Too often the users or general management notice the apparent inconsistencies that this causes and distrust the computerized information. Inability to keep redundant data in the same state of update is a common cause of the anti-computer stories that managers too often tell.

The file processing system can be visualized as in figure 1. It is firstly used for routine processing and the difficulties arise when there is an ad hoc processing request.

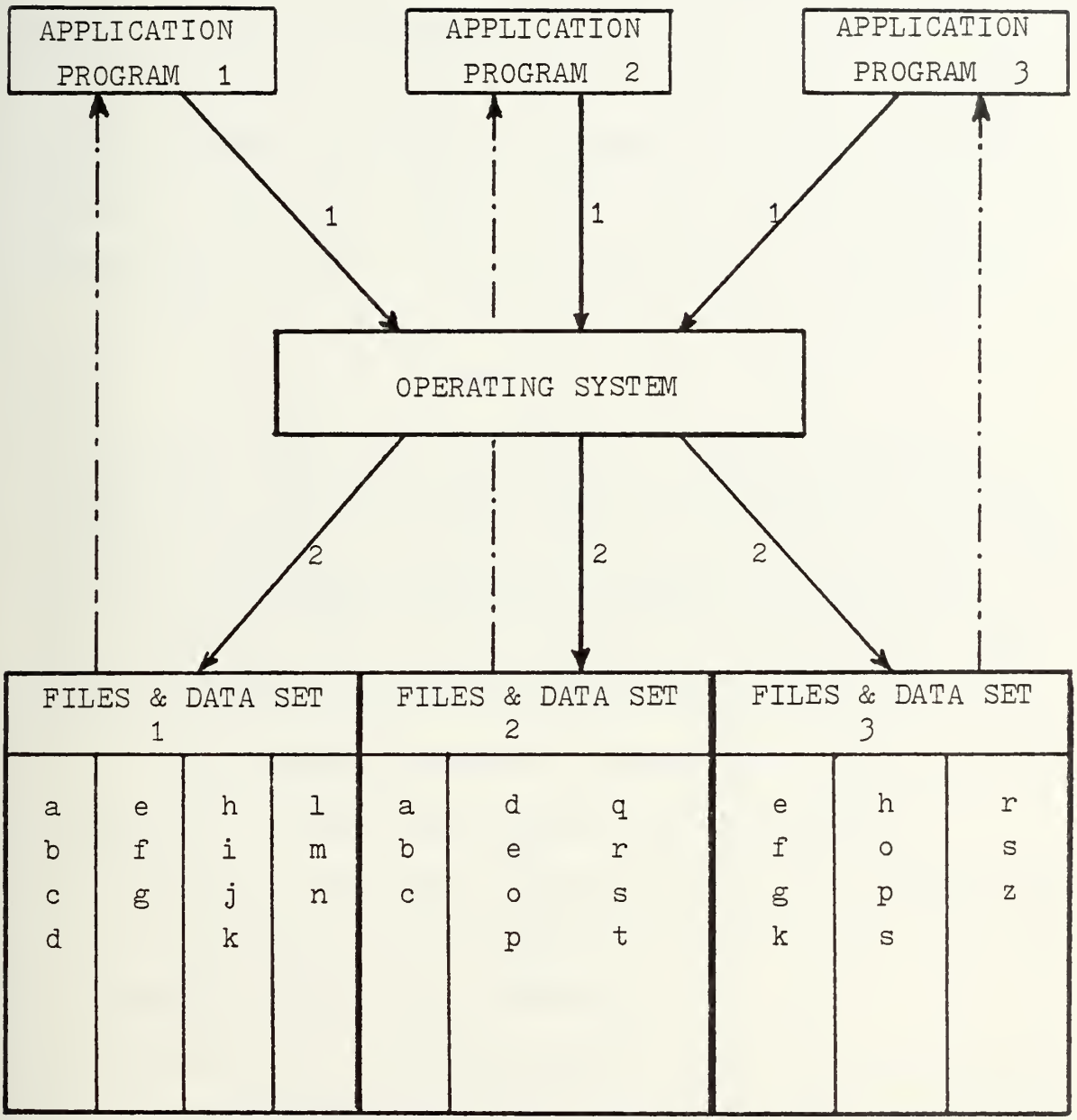

Figure 1. File Processing System.

2. Database Processing System

Too many problems arise with the file processing system as the demand for information processing moves upward towards the upper management levels. They usually have ad hoc request for processing the available data, which is already locked in other application programs, to produce different information for a new application. The file processing system cannot provide sufficient response to this request.

The database processing system solves the above problem. Martin defined that [Ref. 3]:

> A collection of data designed to be used by different programmers is called a data base. We will define it as a collection of interrelated data stored together with controlled redundancy to serve one or more applications in an optimal fashion; the data are stored so that they are independent of programs which use the data; a common and controlled approach is used in adding new data and modifying and retrieving existing data within the data base. One system is said to contain a collection of data bases if they are each entirely separate in structure.

The database processing system can be visualized as in figure 2. It has the following characteristics:

1) Different application program used by the programmers see different data relations. The relation is called logical relation or subschema.
2) Those many different relations seen by the application programmers derived from a common overall relation that covers all data. It is called schema.
3) The schema should contain as many relations as possible as long as the relations will more likely be used.
4) The schema is independent of how data will be stored physically (physical database description).

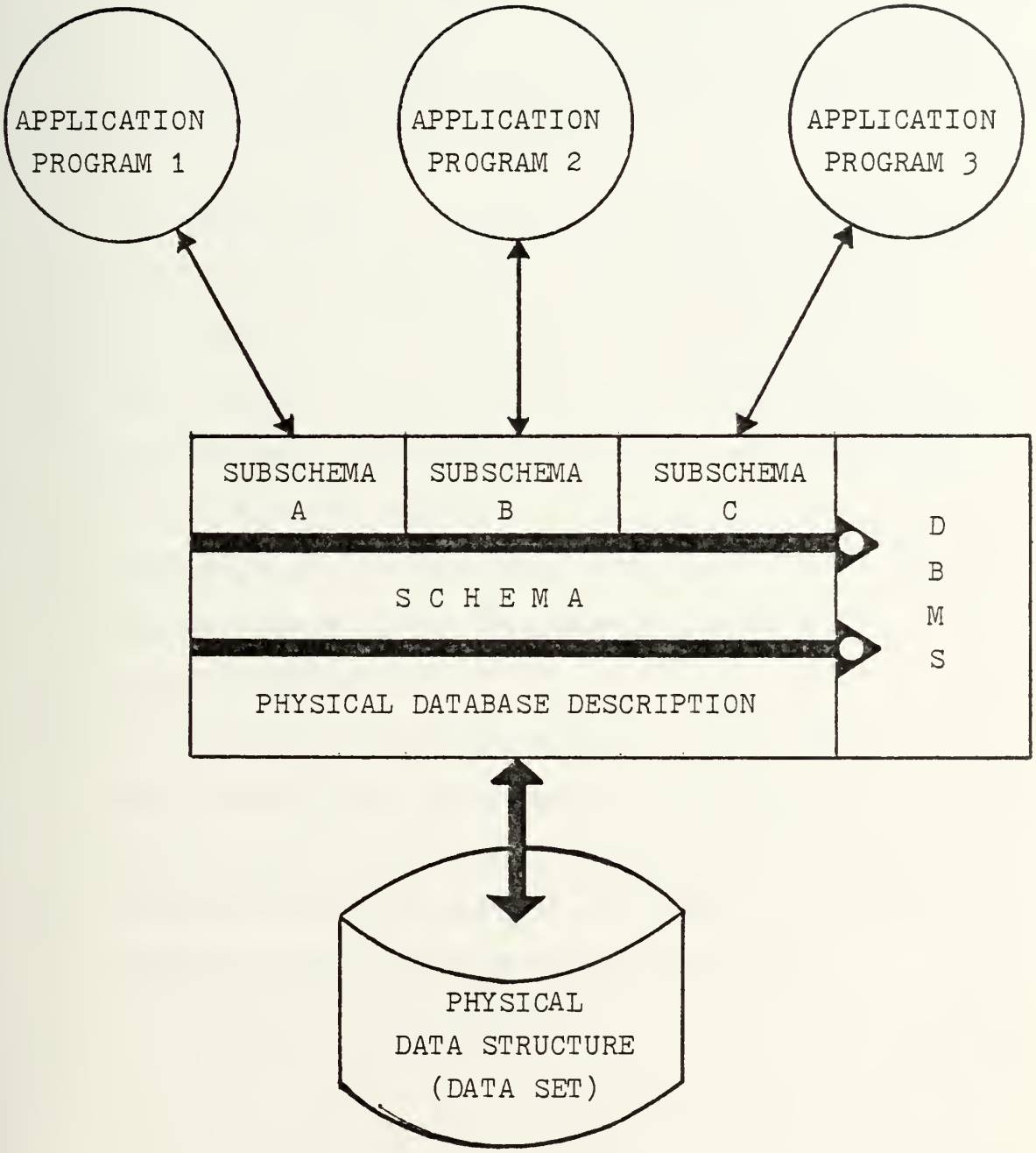

Figure 2. Database Processing System.

5) The mapping from subschema to schema and then to the physical database description is done by the database management system (DBMS) and vice versa.

6) To provide a reference to the physical path necessary to access a particular data element, a schema possesses a data dictionary or directory.

The advantages of database processing systems are:

1) Data integrity; ensures to some degree the accuracy and correctness of the data in the database.

2) Data sharing; ensures the use of the data elements in the database (data set) by multiple users without disturbing each other.

3) Data security; ensures the protection of the data set against unauthorized disclosure, alteration, or destruction [Ref. 4].

4) The evolution of several projected applications is possible through the growing of the schema without interferring with the existing application programs.

5) Databases that were separate can later be combined through database software standardization.

D. DATA PROCESSING SYSTEM AND DATABASE SYSTEM

Any large organization that has moved to computerize its data processing functions usually acquires more than one computer. The computing facility is usually dispersed throughout the organization's decision points or functions. The term "distributed data processing" applies when several stand alone data processing systems exist to process information when this is the most effective way to satisfy operational, economical, or geographical conditions. In distributed data processing, local computers can communicate with each other and with a central computing facility through the use of telecommunication facilities, but the processors of the computers do not interact with each other, although they may share storage devices.

A "distributed system" has been defined as one in which there are several autonomous but interacting processors and/or data stores at different geographical locations. However, the physical distribution of hardware without dispersing the processing function does not constitute a distributed system. It does not necessarily imply that a local computer in a distributed system is unable to function as a stand alone data processing facility. Distributed system is a new technology especially when involving database system in it.

Centralized data processing is the antagonist of distributed data processing. In centralized systems all work is done at a processing center with remote users serviced via data communication links.

Two classes of distributed system can be identified: hierarchically distributed and horizontally distributed. In the hierarchically distributed system the processors share tasks in a structured way with each component to some degree controlled by the higher level members of the hierarchy. In the horizontally distributed system all processors cooperate at an equal level, logically, to perform a set of tasks. In many cases, the computer systems are large-scale information processors supporting local terminal systems. All of the above terms were taken from Refs. 1 and 5.

Different classes of database systems exist in either a hierarchical or horizontally distributed system. The classes arise as a result of two considerations: data set objectives and communication objectives. Data set objectives are concerned with the control and effective usage of the organization's informational resources. It is done through the improvement of data integrity and data availability (accessibility and sharing). Communication objectives are to minimize the volume and path length of the communication traffic.

The database system classification is determined by the manner in which three major components of the database system are organized such that the distributed system can perform as a single total database system have the choices of different kinds of splitting the data set, different kinds of splitting the directory (and possible also the schema), and where to locate the programs (DBMS and user program). The

Table 1: Advantages and Disadvantages of Data Set distribution methods. Data Set refers to Data Base in the original copy.

Type of Distribution	Advantages	Disadvantages
Common data set accessed by all processors. (Centralized)	No duplication of data, little reorganization required.	Contention among multiple processors attempting to access data simultaneously. Data set is large, so response time is slow. During disk failures, all processors lose access to data.
Copy of the common central data set stored at each processor. (Replicated)	Each processor has access to data set without contention. Fast response time. During failure, new copy can be obtained.	High storage cost due to extensive duplication of data. Updates of one copy must subsequently be made on all other copies. High data set reorganization costs.
Individual data set for each processor in the ring. (Partitioned)	No duplication of data minimizes storage cost. Size of data set determined by application of node, not total corporate requirement. Fast response time.	Ad hoc or management reports must be obtained from different data sets.

choice of where to locate the programs is more communication oriented and not independent of the choice of the data set splitting and directory splitting. The feasible database system classes also ties the choice of the directory splitting to the choice of the data set splitting. Three choices to the data set splitting are centralizing, replicating, and partitioning. Each choice has the advantages and disadvantages as listed in table 1 [Ref. 1].

The directory is needed by the DBMS to locate the physical records in the data set. The placement of the directory components can affect system loading, availability, volume of communication links, response time, and overall system complexity [Ref. 1]. The directory can be centralized, distributed, or local. In the centralized directory location, regardless of the level of distribution of the data set, it is located in one computer complex. Subsets of the directory may be placed at local computer centers if subsets of the data set are stored locally. In the distributed directory location, the entire directory for the complete data set is stored at each local computer center. In local directory location, the portion of the directory associated with the local data set is stored in the local computer complex and that portion is not stored in any other computer installation. It is associated with the partitioned data sets. The characteristics of various combinations of data set distributions and directory distributions are summarized in table 2 [Ref. 1].

Table 2: Characteristics of Various Combinations of Data Set Distribution and Directory Location. Data Set refers to Data Base in the original copy.

Data Set Distribution	Directory Location		
	Centralized	Distributed	Local
Centralized	Feasible combination. Minimum Storage (1). Moderate Communications (2).	Feasible combination. Moderate Storage (6). Moderate Communications (2).	Not a feasible combination.
Replicated	Feasible combination. Moderate Storage (3). Moderate Communications (4).	Not a feasible combination.	Not a feasible combination.
Partitioned	Feasible combination. Moderate Storage (1). Moderate Communications (5).	Feasible combination. Moderate Storage (6). Moderate Communications (5).	Feasible combination. Minimum Storage (7). Minimum Communications (8).

(1) Depending upon the number of dispersed subsets of the directory.
(2) Depending upon data requests and processing against the data set.
(3) Depending upon the number of dispersed subsets of the directory and the number of existing copies of the data set, in whole or in part.
(4) Depending upon whether requesting and responding nodes are the same.
(5) Depending upon whether requesting and responding nodes are the same and whether directory changes are required.
(6) Depending upon the number of complete copies of the directory.
(7) Because the data set and directory are partitioned with no duplications.
(8) Because data sets needed locally are stored locally.

IV. SELECTION CONSIDERATIONS

A. HANKAM AND ITS MIS

1. Organization

As with other conventional organizations, the HANKAM Department was developed to achieve certain objectives. The HANKAM Department simplified organizational structure can be viewed in figure 3. Its goal is concerned with the achievement of national security in general. Its plan and the organizational structure reflect how the goal will be achieved.

In making the policy and developing the strategic plan, HANKAM Minister/Commander in Chief of the Armed Forces is supported by HANKAM General Planning Staff. Information is needed to perform their function. The information used in this level is primarily gathered from outside of the organization. The information from within the organization is a highly summarized one, the information that is generated firstly by the activities down below throughout the entire organization and filtered or summarized as it flows upward following the organization structural hierarchy.

The HANKAM functional staff responsibility is the management of some specific functional area in conjunction with the various resources to support the goal of the department. In running the department, the management of HANKAM is assisted by Supporting Activity Agencies such as Research and Development Agency, Data Processing Center, Training and

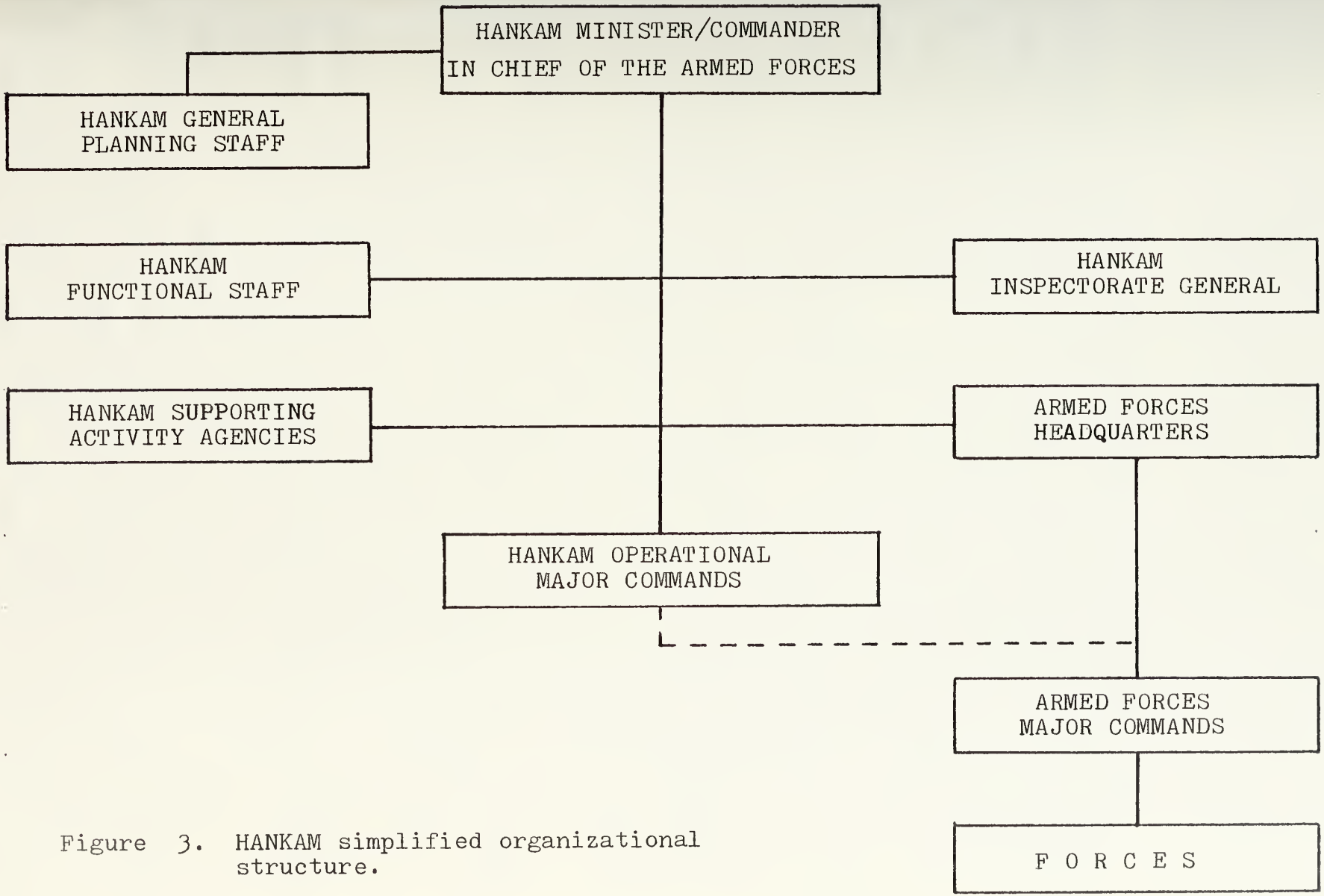

Figure 3. HANKAM simplified organizational structure.

Education, Health and Medication, and many others. The Inspectorate General conducts the department control function to ensure that subordinates perform their functions as intended.

To achieve the objectives of the department that covers this wide area, the goal is broken apart into various missions that should be accomplished by the HANKAM Operational Major Commands and the Armed Services components, utilizing resources available. The accomplishment of the mission is their main objective. Each component of the Armed Forces is responsible for managing and preparing the combat readiness of their forces. For the Police, it is also subject to the accomplishment of the law enforcement. The Indonesian deterrent strategy for security divides the national geographical area into four compartments. The mission of each one of the four HANKAM Operational Major Commands is concern with the planning and operation of combat strategy of each compartment. In accomplishing the mission, they are also supported by the combat forces of the armed forces major commands.

The management of the HANKAM Department develops a plan for the allocation of its resources among the various missions in accordance with the national defense and security policy. They measure and control what the allocation actually is, observe and analyze the effect of the allocation and adjust the allocation policy and plan as required.

The same management philosophy and principles are also applied to the management at the armed forces level. It has a similar organizational structure and procedures as

the HAWKAY Department with its Inspectorate General, functional staff, supporting activity agencies, and major commands.

In summary, to perform their task, subordinates have authority delegated from their superiors. Decision making points are dispersed throughout the entire organization according to responsibility for mission accomplishment. Each level and function may have their own type of decision activities caused by the different nature of each individual mission.

2. Data Processing System and MIS

When considering an MIS we are faced with many disagreements about definitions. Head [Ref. 6] stated: "Definitions abound, but there is no consensus among the numerous contributors to the literature as to what really constitutes an MIS." For the purpose of this thesis, the author considers it as principally involving a system that provides information needed by the various levels and functions of management within the organization in their planning decision making process. However, it is worthwhile to consider the information system as a whole before discussing the MIS.

Regarding the way information is being collected, it can be divided into two classes, namely formal and informal information. Informal information is usually generated by personal contact and rumor. This type of information is widely used by upper level management especially concerning the information from outside of the organization. Since this information is poorly defined and unstructured in nature,

in using this information for a decision, the management is required to make estimates and judgements based on their experiences and to combine it with the formal information.

In a conventional organization formal information is collected through channels up and down in accordance with the organization hierarchical structure. The channels are embodied within this structure through the organization's procedures. The major part of this information is generated by the activities at the operational level of the organization. This channels work very effectively if used in the top-down fashion but not in the bottom-up direction. Management spends most of its time transforming information generated by the lower level management or subordinates into useful information needed by their superiors. Current technical discussions try to upgrade the effectiveness of this bottom-up version by utilizing computer capabilities which apply to MIS implementation.

In general, an information system of an organization can be categorized and visualized as in figure 4. Operating Information System (OIS) is the system that collects, maintains, and processes basic data required for record keeping and to support a decision making process. The part of OIS that transform raw data into one or more types of information is called Data Processing Information System (DPIS). The part of DPIS that processes data into information which is used to bring the system into a predetermined stable condition without direct human participation is called the

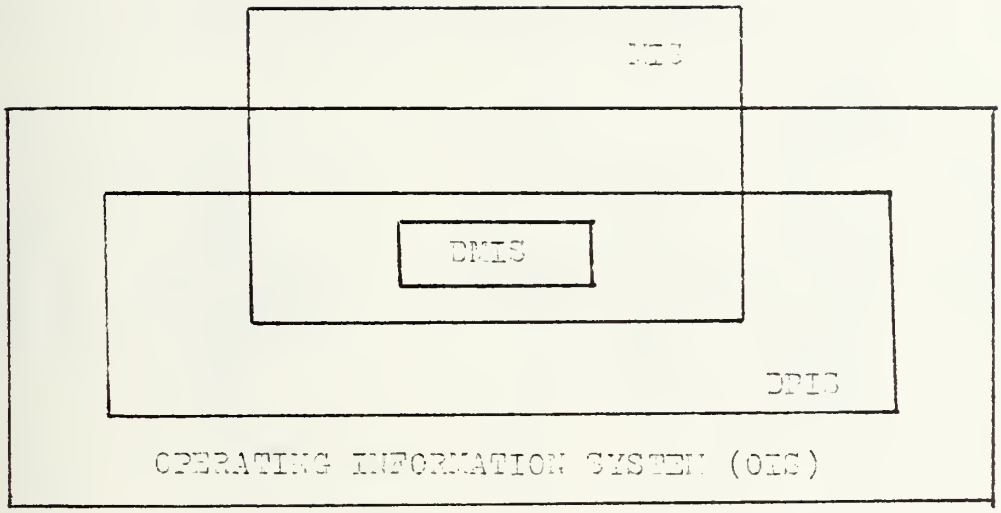

Figure 4. Categories of information systems.

Decision Making Information System (DMIS). Currently, perhaps no organization possesses a DMIS. The MIS which is used to maintain the dynamic control over the organization consists of three parts. The first part is the one in accordance with the information generated outside of the OIS and mainly comes from outside of the organization. The second part is the information generated by the OIS but not processed by the DPIS, and the third part is the one processed by DPIS. Our discussion in this thesis is primarily concerned with the later which utilizes the database with its computer. However, it does not mean that we can neglect the OIS as a whole, since the data processed by the DPIS comes from the other part of the OIS.

The major formal information flow for HANKAM which is used in the planning and decision making process and for

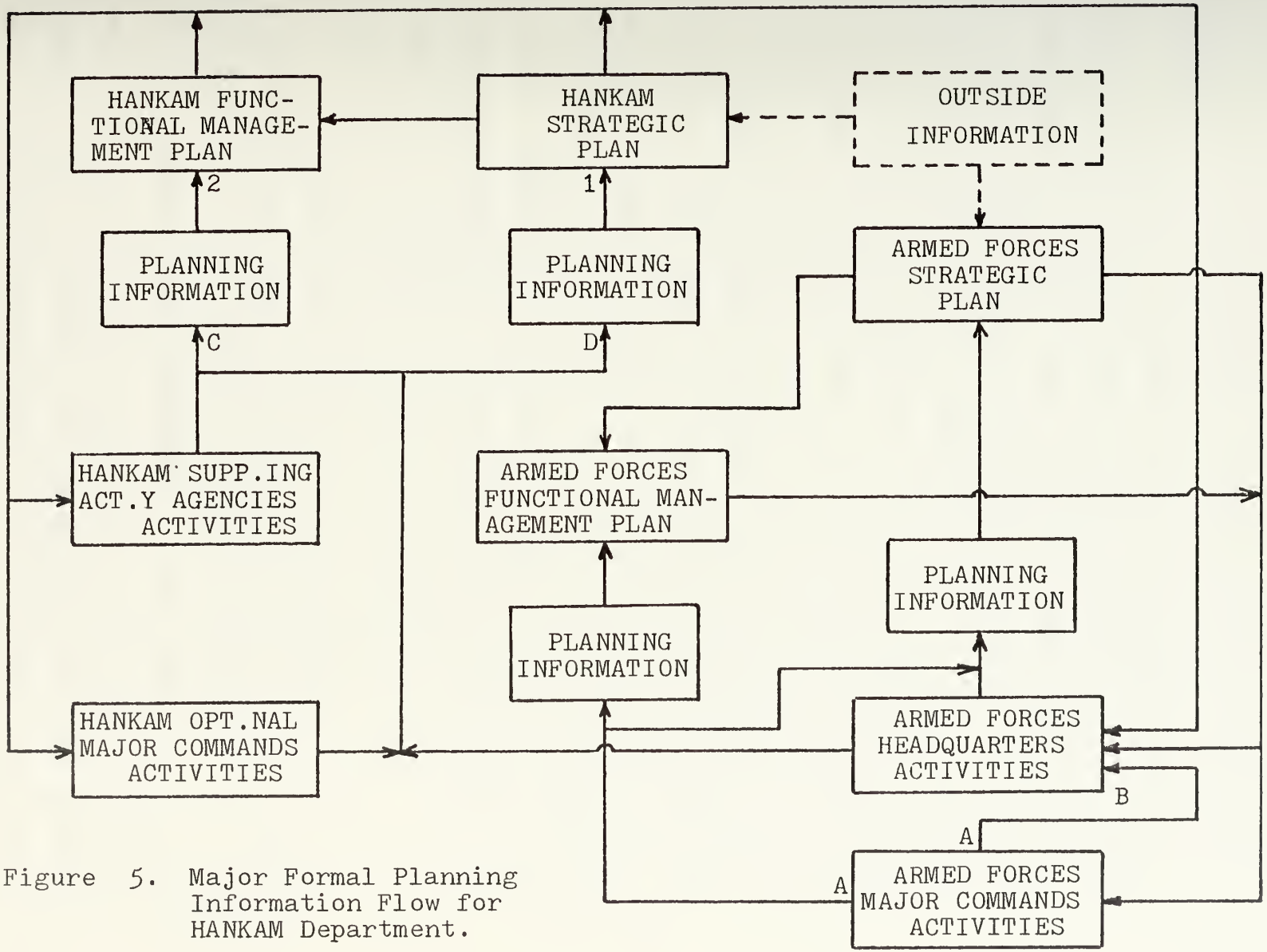

Figure 5. Major Formal Planning Information Flow for HANKAM Department.

record keeping can be visualized as in figure 5. The flow following the organization's structure that is shown in figure 3.

The HANKAM strategic plan is developed using two major information sources, one from outside of the organization and the second from within the organization. The formal part of the information that comes from within the organization will be a highly summarized one. It comes from the activities of HANKAM Supporting Activity Agencies, HANKAM Operational Major Commands, and Armed Forces Headquarters. The same information sources also provide formal information for HANKAM functional management for accomplishing their functions. As a guide in developing the HANKAM functional management plan, it refers to the HANKAM strategic plan. Information that comes from the Armed Forces headquarters are actually summarized information originating from their subordinates, namely the Armed Forces Major Commands and the Supporting Activity Agencies of the Armed Forces. It follows path A, B, C to 2, and path A, B, D to 1.

As mentioned earlier in the preceding section the management must plan and conduct various activities regarding the allocation of available resources and measure its effect on the organization's performance. The basic resources that are considered the most important by HANKAM management are: people, money, material, and information that is relevant to the national security strategy. It is reflected in the HANKAM MIS, which is divded into four subsystems. They are the

personnel subsystem, financial subsystem, material subsystem, and combat strategy subsystem. Because of the different nature of the last subsystem in all aspects, it will not be discussed further.

The HANKAM Department has decided to develop and implement the MIS function. The authority for developing and implementing the HANKAM MIS function was given to one of the many HANKAM Supporting Activity Agencies. For the Armed Forces level, each service has its own organization, this is one of the Supporting Activity Agencies at the Armed Forces level.

In a manual system, the data processing function is embodied within the organization's hierarchical structure. Implementing a computerized information processing system implies the separation of the processing function from the management, consequently an independent data processing function is established. The degree of separation, thus the degree of control exercised over the new processing function, determines whether a data processing function is centralized, hierarchically distributed, or horizontally distributed.

Regardless of the operational data processing type, the formal planning information flow for HANKAM Department (Fig. 5) can be visualized as in figure 6. For the computerized system, the data processing function can be either centralized, hierarchically distributed, or horizontally distributed.

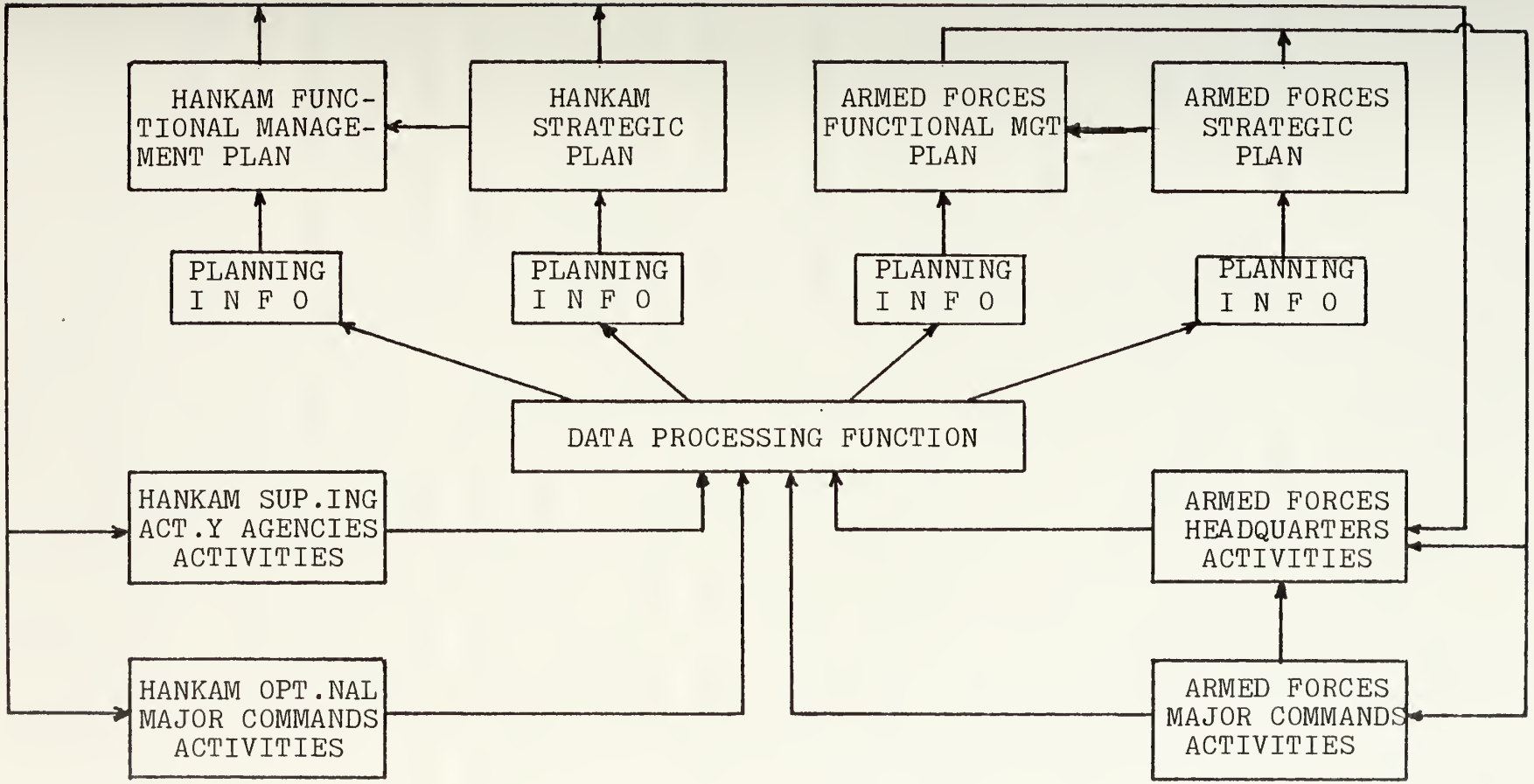

Figure 6. Computerized Information Flow for HANKAM/ARMED FORCES in planning process.

B. PEOPLE CONSIDERATIONS

When a new advanced technology is being introduced, it is too often accompanied by mechanistic assumptions about the organization and its human members [Ref. 7]. The problems begin to arise and evolve when it comes into implementation and operation where people are involved. While people have the capability of being adaptable, resentment is likely to occur if the adaptation is coerced and if it disturbs the preferred human system. During the early nineteenth century, the industrial revolution created social change problems. The unrest of employees at Lordstown is somewhat symbolic of the new generation of workers who revolt against jobs which are inhumanly dull and/or that involve inconsiderate pressure to produce [Ref. 8]. Nolan identified a crisis somewhere in stage three of his six stages of data processing growth, the point where the EDP function changes become an MIS function. This may impact significantly the continuation of system growth [Ref. 9]. A significant impact on middle management caused by certain MIS computer application cannot be tolerated by some individuals. "....each incident of technology transfer contains a fascinating story full of technological complexity and human drama." [Ref. 10].

According to Dickson [Ref. 11], on the attempt to design, develop, and implement an MIS:

> "Such topics as project identification and selection, project time and cost estimation, project control and documentation, and the entire area of operations management were felt by the firms to be far less crucial than topics involving people problems in some way. The conclusion is

inescapable that, in order to achieve the technical benefits of management information systems, the dysfunctional side effects stemming from behavioral problems must be minimized, and that any systems designer who gives a complete hardware description to his charge without suggesting or forecasting problems in the social system does a disservice to himself and to his organization.'

Some of the typical patterns of employee behavior that can adversely affect the success of an MIS project are aggression, projection, and avoidance. Table 3 summarizes the specific factors that may be most important in causing dysfunctional behavior in each organizational group [Ref. 11]. In the operating group, nonclerical personal refers to one that provides inputs to the system, and the clerical personnel refers to those that are closely related to the inputs that will be processed and converting them into outputs. Operating management group consists of first-line supervisors up to and including middle management.

The process in which a new technology is transferred from the existing research into useful actual operation is known as technology transfer. In technology transfer two stages can be identified: intellectual acceptance and putting it into practice during implementation. A worse problem occurs when the implementation affects the higher level of management. Reference 12 (p. 18 and p. 30) stated the dynamics of the transfer process within an organization:

Technological change and innovation occur as the result of complex sets of human interactions, information flows and transfers, individual and organizational creativity, and individual and organizational risk-taking and decision-making.

Table 3: Reasons for resistance to MIS (by working group).

	OPERATING		OPER-ATING MANAGE-MENT	TOP MANAGE-MENT
	NON CLERICAL	CLERICAL		
Threats to economic security		X	X	
Threats to status or power		X	X*	
Increased job complexity	X		X	X
Uncertainty or unfamiliarity	X	X	X	X
Changed interpersonal relationals or work patterns		X*	X	
Changed superior-subordinate relationships		X*	X	
Increase rigidity or time pressure	X	X	X	
Role ambiguity		X	X*	X
Feelings of insecurity		X	X*	X*

X = The reason is possibly the cause of resistance to MIS development.
X*= The reasonshas a strong possibility of being the cause of resistance.

Change is the way of life. Resistance to change is also a way of life. The only way that successful change can take place is to overcome the resistance to it and provide the proper organizational conditions to enhance it.

The HANKAM Department has decided to develop an MIS function and a Master Plan and a guide for the development has been established. A five year program that is derived from the Master Plan is reviewed and revised annually as needed. The program contains phases of the implementation which cover the four subsystems that will be based on the computerized data processing system. Current development of the various applications in each subsystem are mostly still in the stage of system study and definition. Subordinates

cannot reject current and future stages of the development formally. If there is any resistance to the past and future stages of the development, it will be in some form from the underground that is hard to visualize. The following are suggestions that have been given by some authors to reduce potential problems or resistance [Refs. 8 and 13]:

1) Some kind of education, formal or informal, should be given to the management group that will be affected by and involved in the development process and operation of the CIS.

2) Individuals affected by computers would be sincerely invited to participate in the planning, designing, and implementation of computer applications.

3) Ideally there should be an organization-wide approach to the design of MIS, since all subsystems should be integrated to assure that the overall system will function in the best interest of the organization as a whole.

4) The levels of the MIS are planned to be responsive to the levels of responsibility in the organization.

5) MIS should not be installed unless the managers for whom it is intended are knowledgeable enough to evaluate and participate with it rather than be controlled by it.

6) Use computerization as an opportunity to develop employees - not to reduce their importance or to get rid of them.

7) Determine with the employees affected by computers how the new system can provide them with more job freedom.

8) MIS planning should be a continuing effort, since organizations and information should be responsive to change.

9) Actual implementation can proceed by subsystems, since it probably would be impractical to implement all subsystems of the MIS simultaneously.

V. CONCLUSION

Undoubtedly, a database system with its processing capability is appropriate as part of the OIS in an MIS application. Which one of the many classes of the database systems to choose is primarily determined by the type of OIS. It can be either one of centralized data processing, distributed data processing, no distributed system. Unfortunately, there are no standard metrics to measure. It depends on the characteristics of the organization and the environment of the development process such as vendors, facilities, technical expertise, and many others.

For the HANKAM Department that builds the OIS from scratch, and does not have previous ADP experience, we should consider the people problems most seriously. We can identify and judge two major areas: reducing people problems and reducing non-people problems. The later can further be divided, in the context of HANKAM Department, into minimizing technical complexity and minimizing costs the OIS classes as in figure 7. The author assigns weights of 60% for people problems and 40% for non-people problems. From the figure it can be seen that distributed data processing is the best system for current HANKAM Department. The consequence is that we must have many stand alone database systems for each main decision point. This is confirmed with what is stated by the following [Ref. 3]:

Figure 7. CIS choosing by measuring the ease of its implementation. The ratio of the people problems to non-people problems is considered as six over four.

	Reduction of people problems	Reduction of complexity	Least cost	Total
Centralized Data Processing	15	8	9	32
Distributed Data Processing	23	7	6	36
Distributed System	22	5	5	32
TOTAL	60	20	20	100

A better way to think of data-base management systems is that they form an infrastructure which will allow the corporation's various schemas to grow and interlink over the years, becoming more useful as they do so. Furthermore, the schemas can grow without the prohibitive costs of rewriting application programs, and schemas do not have to be changed when the hardware is changed.

If schemas across the corporation are to be interlinkable and transferable from one plant to another or from one data-processing system to another, they should all be written in the same data description language. At today's state of the art, then, most corporations should not talk about a corporate-wide data base but rather a corporate-wide organizing principle which forms the structure for data-base development. An essential of this principle is that the schema description language and data dictionary be standardized throughout the corporation.

In terms of the environment of the operational database system, it means that having the evolution from distributed data processing to a distributed system can be considered later. Let the experimental or growing phase of distributed system, which is a new technology, be pioneered by those who have sufficient resources and related urgent needs. For

most organizations, especially the HANKAM Department, it is better not to utilize the distributed database system until its development is mature. The transition from a manual system to a computerized MIS, with a database system, represents a major improvement for the HANKAM Department. For the distributed data processing system chosen, by considering the personnel, financial, and material subsystems involved, the computerized information flow structure will look like that shown in figure 3. There will be five groups of databases, one for the HANKAM Department, and one for each of the four Armed Service components.

Each database group consists of mainly personnel database, financial database, material database, and integrated database. The integrated database will contain a data set supplied by the personnel, financial, and material databases. The relations of the data item are structured to provide fast response to ad hoc information requests by the general management. The personnel, financial, and material databases are designed for the related functional management. Data item of the HANKAM functional databases are supplied by the related Armed Services functional databases and by data from the HANKAM Supporting Activity Agencies and the HANKAM Operational Major Commands. The details of the HANKAM functional data set and schema may be different from the one in the Armed Service level.

With the structure that is shown in figure 8, the tailoring of the information generation and availability to the task at each decision point, as suggested by Nichols [Ref. 14] can be made available.

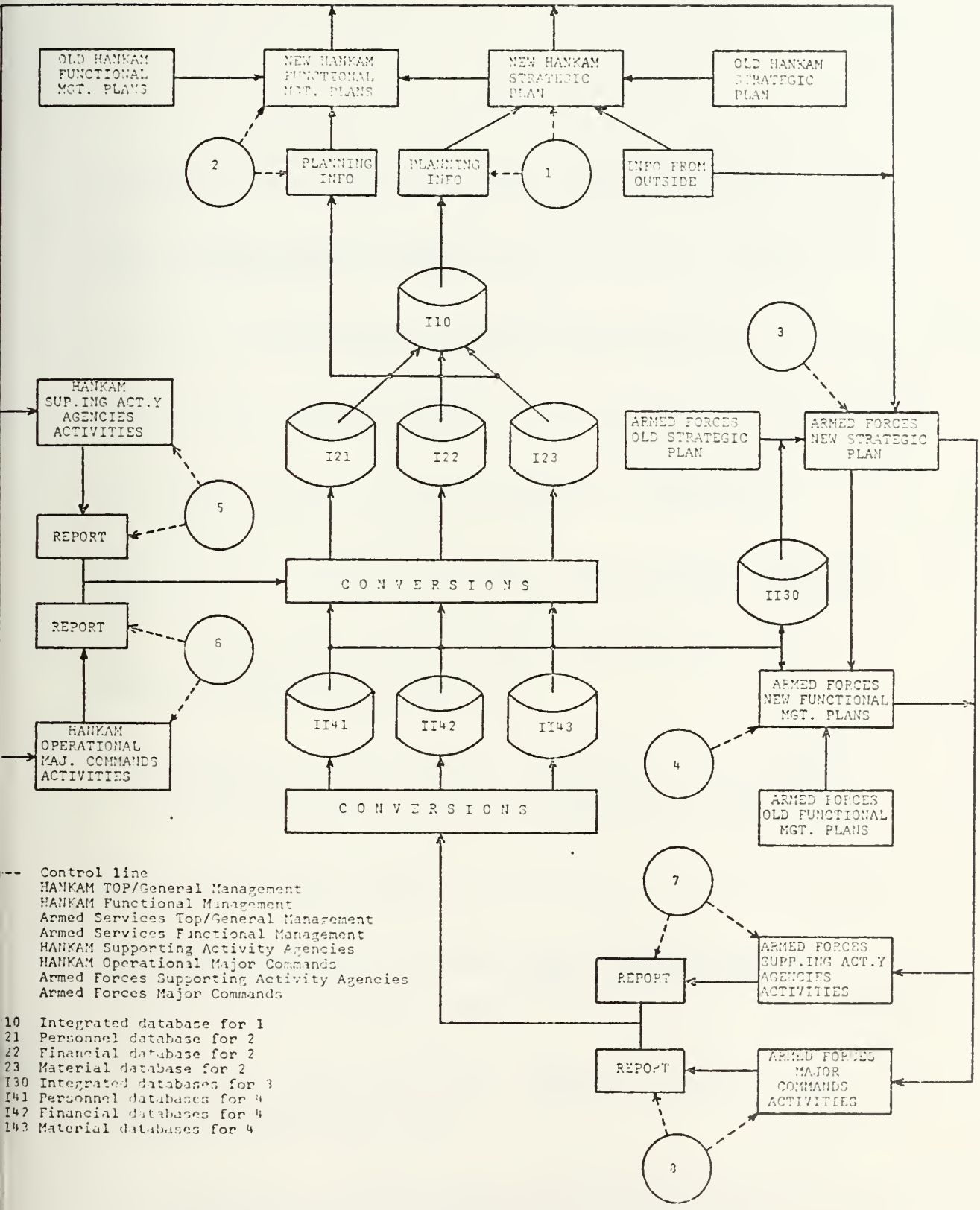

Figure 8. Computerized Information Flow Structure for HANKAM MIS.

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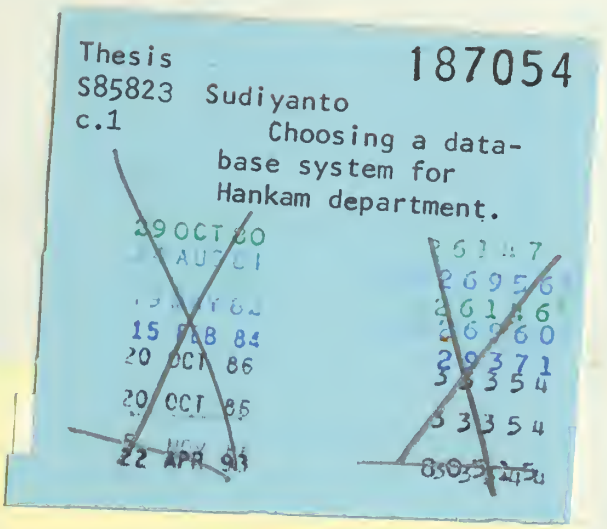

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Choosing a data-
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